Remarks

Thorough examination by the Examiner is noted and appreciated.

The Specification has been amended to make the title of the invention more descriptive and to address Examiners noted errors in the Drawings and the Specification in accordance with Examiners suggestions.

The claims have been amended to more clearly claim Applicants invention.

Support for the new limitations in the amended claims are found in the original claims and the specification.

Support for new limitations in independent claims 1, 11, and 20 are found in the original claims and in Figures 2 and 3.

Support for newly added claims 21-26 are found in the original claims and specification including a Brief Description of the Drawings.

Specifically support for new claims 21 and 22 are found in paragraph 0038 on page 17.

The remaining amendments find support in original claims and/or the specification. No new matter has been entered.

Claim Rejections under 35 USC 112 2d paragraph

Applicant has amended claim 1 to overcome Examiners rejection.

Claims 5 and 16 have been cancelled thereby avoiding Examiners rejection.

Claim Rejections under 35 USC 102(b)

Claims 1-20 stand rejected under 35 USC 102(b) as being anticipated by Lin, et al. (US Patent 6,042,999).

Lin et al. teach a dual damascene process **by filling a via opening** with protective material prior to formation of a conductive line (trench line opening) (see Abstract) Lin et al. teach a process whereby a lower level dielectric layer, an etch stop layer and an upper dielectric layer (see e.g., col 4, lines 55-67, each having a thickness between about 8000 Angstroms and about 15000 Angstroms (see col 5, line 9) are formed prior to patterning a resist layer to etch a via opening though a thickness of the lower and upper level dielectric insulating layers (IMD layers)(see col 5, lines 20-25). After removing the

resist layer, Lin et al. teach depositing an ARC material to fill the via opening, the ARC layer implicitly having a thickness at least about equal to twice the thickness of the upper and lower dielectric insulating layers, e.g., at least about 16000 Angstroms to about 30,000 Angstroms(see e.g., col 5, lines 35-39, Figure 2C). Lin et al. then teach removing a portion of **the ARC filled via opening** to about a level of the intervening etch stop layer between the upper and lower dielectric layers following deposition and patterning of a second photoresist layer (see col 5, lines 67-65).

Applicants do not claim filling the via opening, but rather claim in amended claim 1:

"forming an antireflectance coating (ARC) layer over the IMD layer such that the ARC layer is formed over sidewalls of the at least one via opening **without filling the at least one via opening**; and,

depositing a photoresist layer over the IMD layer and photolithographically patterning a trench opening over the at least one via opening."

Lin et al., further do not teach or disclose forming a first ARC layer over the IMD layer prior to forming via openings followed by **forming** a second ARC layer to cover via opening sidewalls **without filling the at least one via opening** as claimed by Applicants in amended claims 1, 11, and 20, and **substantially conformally** depositing or forming as claimed in Applicants amended claims 11 and 20.

"providing an inter-metal dielectric (IMD) layer comprising a first anti-reflectance coating (ARC) layer over the IMD layer;

forming via openings extending through a thickness portion of the IMD layer;

substantially conformally depositing a second ARC layer over said IMD layer and the via openings to cover the via opening sidewalls; and,

forming a photoresist layer over ~~said~~ the IMD layer and photolithographically patterning trench openings disposed at least partially over ~~said~~ one or more of the via opening~~s~~."

Lin et al. further do not teach forming an etch stop layer (e.g., second dielectric layer) underlying the first ARC layer prior to forming a via opening followed by substantially conformally depositing a second ARC layer to cover via opening

sidewalls as claimed by Applicant in amended dependent claim 13 and amended independent claim 20.

The filling of the via opening as taught by Lin et al. with ARC material clearly does not anticipate Applicants disclosed and claimed invention. Applicants have amended claim 1 to further make clear, consistent with Applicants disclosure, that the ARC layer is formed **without filling the via opening.** Further in amended claims 11 and 20 Applicants claimed **substantially conformally forming** an ARC layer such that the ARC layer is formed over the via sidewalls is inherently inconsistent with filling the via opening as taught by Lin et al. One of ordinary skill would understand the term "conformal" to mean depositing a layer over the top and sidewalls to about the same thickness which is clearly not implicit or explicit in the disclosure of Lin et al.

Contrary to Examiners assertion, Lin et al. do not explicitly disclose a thickness of the ARC material as claimed by Applicants in claims 8 and 17, but rather implicitly disclose a thickness of between about 16000 Angstroms and about 30,000 Angstroms to fill the via opening based on the disclosed dielectric layer thicknesses. Further, Examiner argues that by disclosing the deposition of an intervening etch stop layer

between the upper and lower dielectric layers that this inherently supports deposition of an ARC layer to the same thickness. Clearly, no such inherency is supported since such a thickness would not fill the via opening as taught by Lin et al. Examiner also argues that the intervening etch stop layer taught by Lin et al. also inherently support forming a first ARC layer over an IMD layer prior to forming a via opening therethrough. Again, no such inherency can exist since depositing an ARC layer between the lower and upper dielectric layer would not serve the function of an ARC layer in either the via or trench etching processes as claimed by Applicant. Lin et al. do not disclose forming any layer, either an etch stop or another ARC layer over the IMD layer prior to forming a via opening. The formation of an ARC layer of the IMD layer prior to forming a via opening is neither disclosed not suggested by Lin et al.

"The fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic." In re Rijckaert, 9 F.3d 1531, 1534, 28 USPQ (Fed. Cir. 1993).

"To establish inherency, the extrinsic evidence must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so

recognized by persons of ordinary skill." In re Oelrich, 666 F.2d 578,, 581-582, 212 USPQ 323, 326 (CCPA 1981).

"In relying on the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic *necessarily* flows from the teachings of the applied prior art." Ex Parte Levy, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990)

Claim Rejections under 35 USC 103(a)

Claims 1-20 stand rejected under 35 USC 103(a) as being unpatentable over Lin et al., above, in view of Yu et al. (US Pat.No. 6,027,861) and further in view of Filipiak et al. (US Pat. No. 5,918,147).

Applicants' attorney of record state that Lin et al. (US Pat No. 6,042,999) and Applicants invention were, at the time of Applicants invention, owned by, or subject to an obligation of assignment to Taiwan Semiconductor Manufacturing Corporation (TSMC). Therefore, Assistant Examiners use of Lin et al. in a 102(e)/103(a) rejection is improper and disqualified under 35 USC §103(C).

However, while not agreeing Lin et al. may be properly be used as a reference in a rejection under 103(a), assuming *arguendo* that it is a properly used reference, Applicants respectfully traverse Examiner's rejection under 35 U.S.C. 103(a).

Yu et al. teaches a method for etching sub-quarter micron openings in dielectric insulating layers by using a thin layer DUV photoresist (see Abstract). In one embodiment Yu et al. disclose forming a via opening by using a Ti/TiN hardmask which also functions as an ARC layer (col 4, lines 58-62). Yu et al. disclose first forming a Ti layer over an IMD layer between 100 and 100 Angstroms followed by forming a TiN layer with a thickness between about 200 and 1500 Angstroms. Yu et al. then teaches using a DUV photoresist between 100 and 1000 Angstroms. Following formation of the via opening.

(A) There is no apparent reason for combining the teachings of Yu et al. with Lin et al., since a dual damascene process is taught by Lin et al. while a single via opening process is taught by Yu et al. Further, there is no suggestion in Lin et al. that an ARC or hardmask layer would be desirable to deposit over the IMD layer prior to forming the via opening. However, even assuming that sufficient motivation exists for combining Yu et

al. and Lin et al., such combination does not produce Applicants claimed invention. Applicants reiterate the comments made above with respect to Lin et al. and further point out that the disclosure of Yu et al. in forming a Ti/TiN hardmask layer that also functions as an ARC layer, does not help Examiner in making out a *prima facie* case of obviousness. Applicants do not disclose or claim a Ti/TiN layer but rather disclose TiN as one of a Markush group for forming a first or second ARC layer. Yu et al. do not discuss, disclose or suggest the desirability of depositing an ARC layer to cover the via opening sidewalls without filling the via opening.

Filipiak et al. disclose the use of multiple ARC layers. Filipiak discloses forming inorganic ARC layers with a continuously graded composition or including a plurality of discrete portions that make up the antireflective layer (see col 2, lines 17-27). Filipiak teaches away from the use of single layers of relatively uniform composition as resulting in problems of adherence, current leakage, or reactivity problems (see col 2, lines 23-27). There is no apparent motivation for combining Filipiak et al. with either Yu et al. or Lin et al. For example Lin et al. teach that either an inorganic layer or organic layer may be used to fill the via opening in contrast with Filipiak et al. who disclose the exclusive use of inorganic ARC layers and

further, do not disclose a dual damascene process. Moreover, a graded or multiple layered ARC layer in the dual damascene method of Lin et al. would serve little purpose in a filled via opening having a thickness of from about 16000 to about 30000 Angstroms, and which is subsequently removed to about the mid-level of the via depth in the method of Lin et al. Since Lin et al. additionally do not suggest or disclose the desirability of using a hardmask or ARC layer over the IMD layer prior to form a via opening in a dual damascene process provides further grounds of lack of motivation for combining Filipiak et al. with Lin et al. Moreover, the multiple layered ARC layers taught and disclosed by Filipiak et al. are not taught as containing any particular etching properties suitable for use as a hardmask in the method of Yu et al. therefore lacking in motivation for combining Filipiak et al. with Yu et al.

Nevertheless, assuming *arguendo*, a proper motivation for combining the references, such combination does not produce Applicants disclosed and claimed invention. Filipiak et al. does not disclose or suggest conformally depositing an ARC layer to cover via opening sidewalls prior to a subsequent photolithographic process to form trench openings over the via openings. Filipiak et al., nor any combination with Yu et al. or Lin et al. disclose or suggest forming a first ARC layer

overlying an IMD layer prior to forming a via opening followed by conformally depositing a second ARC layer to cover via opening sidewalls as disclosed and claimed by Applicants.

(E) Neither Lin et al., Yu et al., nor Filipiak et al. recognize teach or suggest the problem or a solution thereto that Applicants have recognized and solved by their claimed invention. For example, the method of Lin et al. is disclosed as a protective via filling in a subsequent trench etching process and which requires an additional etching step to remove a portion of the via filling. Applicants disclosed and claimed invention solves the recognized problem of light reflections from via sidewalls to undercut a resist layer in a trench patterning process. Further, the disclosed and claimed ARC layer thicknesses of Applicants would not work in the method of Lin et al., clearly being insufficient to fill the via opening depths disclosed by Lin et al. The fact that Yu et al. discloses a Ti/TiN ARC layer, and the fact that Filipiak et al. disclose a graded composition ARC layer, or multiple ARC layers, neither disclosure suggesting application to the formation of a dual damascene structure, clearly fails to make out a *prima facie* case of obviousness with respect to Applicants disclosed and claimed invention.

"First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. **The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure**." *In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).*

"If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the references are not sufficient to render the claims *prima facie* obvious." *In re Ratti, 270 F.2d 810, 123, USPQ 349 (CCPA 1959).*

"A prior art reference must be considered in its entirety, i.e., as a whole including portions that would lead away from the claimed invention." *W.L. Gore & Associates, Inc., Garlock, Inc., 721 F.2d, 1540, 220 USPQ 303 (Fed Cir. 1983), cert denied, 469 U.S. 851 (1984).*

"We do not pick and choose among the individual elements of assorted prior art references to recreate the claimed invention, but rather we look for some teaching or suggestion in the references to support their use in a particular claimed combination" *Symbol Technologies, Inc. v. Opticon, Inc., 935 F.2d 1569, 19 USPQ2d 1241 (Fed. Cir. 1991).*

With respect to the remaining claims, since the teachings of Lin et al., Yu et al. and Filipiak et al. or any combination thereof fail to produce Applicants claimed invention or make out a *prima facie* case of obviousness sufficient under 35 USC 103(a), Examiner has likewise failed to make out a *prima facie* case of obviousness with respect to Applicants dependent claims.

The Claims have been amended to clarify Applicants' invention and newly drafted claims added. A favorable consideration of Applicants' claims is respectfully requested.

Based on the foregoing, Applicants respectfully submit that the Claims are now in condition for allowance. Such favorable action by the Examiner at an early date is respectfully solicited.

In the event that the present invention as claimed is not in a condition for allowance for any other reasons, the Examiner is respectfully invited to call the Applicants' representative at his Bloomfield Hills, Michigan office at (248) 540-4040 such that necessary action may be taken to place the application in a condition for allowance.

Respectfully submitted,

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